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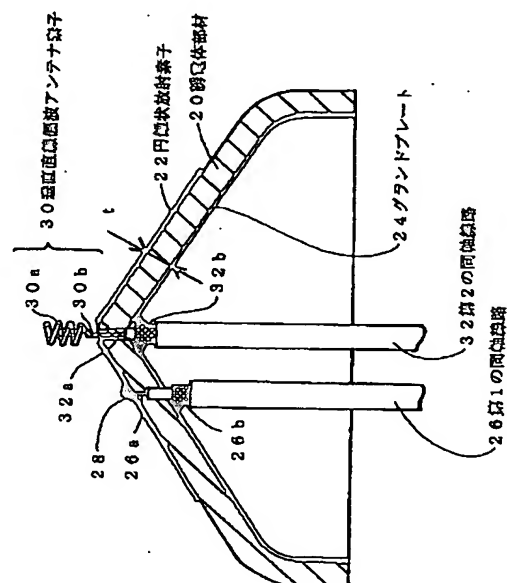
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(54) 【発明の名称】 複合アンテナ

(57) 【要約】

【課題】 衛星波と地上波の双方で送信される放送信号を受信し、衛星波に対して仰角の違いにより利得の変化が少なくまた低仰角でも利得が大きく、さらに地上波に対して低仰角の利得が大きい複合アンテナを提供する。

【解決手段】 上方に凸なる円錐状で厚さが略一定な誘電体部材20の表面に、錐状の頂点を中心として円錐状放射素子22を配設し、誘電体部材20の裏面にグランドプレート24を配設し、円錐状放射素子22に裏面側より第1の同軸線路26の中心導体26aを電氣的接続して、誘電体部材20を挟んで円錐状放射素子22とグランドプレート24で、円偏波を受信し得る円偏波受信パッチアンテナを形成する。第1の同軸線路26の外部導体26bはグランドプレート24に電氣的接続する。また、誘電体部材20の錐状の頂点に、ヘリカルコイルを含んで形成されて垂直直線偏波を受信し得る垂直直線偏波受信アンテナ素子30を上方に突設して配設する。



【特許請求の範囲】

【請求項 1】 円偏波の衛星波と垂直直線偏波の地上波を受信する複合アンテナであって、上方に凸なる錐状で厚さが略一定な誘電体部材の表面に、前記錐状の頂点を中心として錐状放射素子を配設し、前記誘電体部材の裏面にグランドプレートを配設し、前記錐状放射素子に給電線を接続して前記錐状放射素子とグランドプレートで前記円偏波を受信し得る円偏波受信パッチアンテナを形成し、前記誘電体部材の前記錐状の頂点に上方に突設して前記垂直直線偏波を受信し得る垂直直線偏波受信アンテナ素子を前記錐状放射素子と絶縁状態で配設して構成したことを特徴とする複合アンテナ。

【請求項 2】 請求項 1 記載の複合アンテナにおいて、前記誘電体部材を円錐状とし、その表面に円錐状の前記錐状放射素子を配設し、前記垂直直線偏波受信アンテナ素子をヘリカルコイルを含んで構成したことを特徴とする複合アンテナ。

【請求項 3】 請求項 1 または 2 記載の複合アンテナにおいて、前記錐状放射素子に、前記グランドプレート側から前記誘電体部材を貫通して前記給電線としての第 1 の同軸構造の中心導体を電氣的接続し、前記第 1 の同軸構造の外部導体を前記グランドプレートに電氣的接続し、前記垂直直線偏波受信アンテナ素子の基端を、第 2 の同軸構造の中心導体に電氣的接続し、前記第 2 の同軸構造の外部導体を前記グランドプレートに電氣的接続して構成したことを特徴とする複合アンテナ。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】 本発明は、アメリカ本土で放送が開始される X M サテライトラジオ放送およびシリウスサテライト放送などの、衛星波と地上波の双方で送信される放送信号をともに受信するための複合アンテナに関するものである。

【0002】

【従来の技術】 衛星から送信される衛星波と、これを地上局で受信して変調方式を相違させて再び地上局から送信される地上波とを、ともに受信する従来の複合アンテナの一例を、図 9 を参照して説明する。

【0003】 図 9 は、従来の複合アンテナの一例の斜視図である。図 9 において、誘電体板 10 の表面に矩形の面状放射素子 12 が配設され、誘電体板 10 の裏面にグランドプレート 14 が配設され、面状放射素子 12 に裏面側から誘電体板 10 を貫通した給電線（図示せず）が電氣的接続され、面状放射素子 12 とグランドプレート 14 により衛星から送信される円偏波の衛星波を受信する円偏波受信パッチアンテナ 16 が構成されている。また、面状放射素子 12 の中心位置に、上方に突設してヘリカルコイルを含んで構成されて垂直直線偏波の地上波を受信する垂直直線偏波受信アンテナ素子 18 が配設される。なお、垂直直線偏波受信アンテナ素子 18 は、面

状放射素子 12 とは絶縁状態にある。

【0004】 かかる構成の従来の複合アンテナの指向特性は、図 10 ないし図 12 のごときである。図 10 は、円偏波受信パッチアンテナ 16 で衛星波を受信した垂直面内指向特性図である。図 11 は、垂直直線偏波受信アンテナ素子 18 で地上波を受信した垂直面内指向特性図である。図 12 は、垂直直線偏波受信アンテナ素子 18 で地上波を受信した水平面内指向特性図である。

【0005】

【発明が解決しようとする課題】 図 9 に示す従来の複合アンテナにあっては、図 12 に示すごとく、地上波に対して水平面内指向特性は無指向性を示している。また、図示していないが、衛星波に対して水平面内指向特性が無指向性を示すことは勿論である。しかるに、図 10 に示すごとく、衛星波に対して、垂直上方の利得が最も大きく、仰角が低くなるほど利得が低下する。これは受信する場所によりまた複合アンテナが設置される姿勢などにより受信感度に変化を生ずることとなる。そして、図 11 に示すごとく、地上波に対して、水平方向の低仰角における利得が小さい。地上波に対して良好な受信感度を得るためには、水平方向の低仰角の利得が大きいことが望ましい。

【0006】 本発明は、上述のごとき従来技術の事情に鑑みてなされてもので、衛星波に対して仰角の違いにより利得の変化が少なくまた低仰角でも利得が大きく、さらに地上波に対して低仰角の利得がより大きくなるように改善した複合アンテナを提供することを目的とする。

【0007】

【課題を解決するための手段】 かかる目的を達成するために、本発明の複合アンテナは、円偏波の衛星波と垂直直線偏波の地上波を受信する複合アンテナであって、上方に凸なる錐状で厚さが略一定な誘電体部材の表面に、前記錐状の頂点を中心として錐状放射素子を配設し、前記誘電体部材の裏面にグランドプレートを配設し、前記錐状放射素子に給電線を接続して前記錐状放射素子とグランドプレートで前記円偏波を受信し得る円偏波受信パッチアンテナを形成し、前記誘電体部材の前記錐状の頂点に上方に突設して前記垂直直線偏波を受信し得る垂直直線偏波受信アンテナ素子を前記錐状放射素子と絶縁状態で配設して構成されている。

【0008】 そして、前記誘電体部材を円錐状とし、その表面に円錐状の前記錐状放射素子を配設し、前記垂直直線偏波受信アンテナ素子をヘリカルコイルを含んで構成しても良い。

【0009】 また、前記錐状放射素子に、前記グランドプレート側から前記誘電体部材を貫通して前記給電線としての第 1 の同軸構造の中心導体を電氣的接続し、前記第 1 の同軸構造の外部導体を前記グランドプレートに電氣的接続し、前記垂直直線偏波受信アンテナ素子の基端を、第 2 の同軸構造の中心導体に電氣的接続し、前記第

2の同軸構造の外部導体を前記グラウンドプレートに電気的接続して構成することもできる。

【0010】

【発明の実施の形態】以下、本発明の第1実施例を図1ないし図6を参照して説明する。図1は、本発明の複合アンテナの第1実施例の外観図であり、(a)は平面図、(b)は側面図である。図2は、図1の(a)のA-A断面矢視拡大図である。図3は、円偏波受信パッチアンテナで衛星波を受信した垂直面内指向特性図である。図4は、垂直直線偏波受信アンテナ素子で地上波を受信した垂直面内指向特性図である。図5は、垂直直線偏波受信アンテナ素子で地上波を受信した水平面内指向特性図である。図6は、図1の複合アンテナをアンテナ収容筐体に収容した縦断面図である。

【0011】本発明の複合アンテナにあつては、上方に凸なる円錐状で厚さ t が略一定な誘電体部材20の表面に、導電金属板や導電金属薄膜などからなる円錐状の円錐状放射素子22が配設される。誘電体部材20の頂点を中心として円錐状放射素子22が配設され、その頂点は一致する。そして、円錐状放射素子22の縁には、放射状に対向する2箇所に切り欠き状の摂動素子22a、22aが設けられる。また、誘電体部材20の裏面略全面に導電金属薄膜などからなるグラウンドプレート24が配設される。さらに、第1の同軸線路26の中心導体26aが裏面側から誘電体部材20を貫通して、表面にある円錐状放射素子22に半田付け28などにより適宜に電気的接続される。また、第1の同軸線路26の外部導体26bは、グラウンドプレート24に適宜に半田付けなどにより電気的接続される。もって、誘電体部材20を挟んで設けられた円錐状放射素子22とグラウンドプレート24により、円錐状の円偏波受信パッチアンテナが形成される。なお、一例として、XMサテライトラジオ放送の送信周波数の2.3GHzの円偏波の衛星波を受信するための円錐状放射素子22は、その頂角が 125° であり、頂点から縁までの寸法は25mmである。この円錐状放射素子22の受信周波数に対する外形寸法は、誘電体部材20の誘電率により適宜に設定すべきことは勿論である。

【0012】さらに、誘電体部材20の円錐状の頂点に、上方に突設してヘリカルコイル部30aとその基端側が直線部30bとされる垂直直線偏波受信アンテナ素子30が配設される。直線部30bが誘電体部材20の頂点を垂直方向に貫通し、裏面側に設けられる第2の同軸線路32の中心導体32aに電気的接続される。この第2の同軸線路32の外部導体36bは、誘電体部材20の裏面のグラウンドプレート24に半田付けなどにより適宜に電気的接続される。なお、この垂直直線偏波受信アンテナ素子30は、円錐状放射素子22に対して絶縁された状態とされている。そして、垂直直線偏波受信アンテナ素子30は、グラウンドプレート24より上方の部

分がアンテナとして作用し、一例として、共振させるように放送の送信周波数の2.3GHzの $1/4$ 波長の電気長に設定される。

【0013】かかる構成の本発明の複合アンテナにあつては、図3に示すごとく、衛星波に対して、円錐状放射素子22で受信した垂直面内指向特性は、垂直上方から略 $\pm 70^\circ$ の低い仰角まで受信感度はほぼ5dBと略同一であり、しかも $\pm 90^\circ$ の低仰角にあつても、-5dBと、図10に示す従来の複合アンテナに比較して、略3dBほど利得が向上している。そこで、衛星波に対して、これを受信する場所や本発明の複合アンテナが設置される姿勢により受信感度の変化が少ない。しかも、低仰角における受信感度が向上している。もって、衛星波を確実に受信し得る。なお、衛星波に対する水平面内指向特性は、図示していないが、無指向性であることは勿論である。

【0014】そして、図4に示すごとく、地上波に対して、垂直直線偏波アンテナ素子30で受信した垂直指向特性は、 $\pm 90^\circ$ の低仰角においてほぼ1dBと、図11に示す従来の複合アンテナに比較して、略3dBほど利得が向上している。これにより、地上波に対して略3dBほど受信感度の向上が図れている。

【0015】ここで、垂直直線偏波アンテナ素子30に対して、円錐状放射素子22は反射板として作用することから、この反射板を頂角の小さな円錐状とすることで $\pm 90^\circ$ の低仰角の利得が改善されるものと考えられるが、円錐状放射素子22の頂角を 180° から単に減少させても、垂直直線偏波アンテナ素子30の $\pm 90^\circ$ の低仰角の利得が一律に向上するものではなく、増加と減少が交互に生ずる。そこで、発明者らは、反射板としての円錐状放射素子22の頂角を、実験により 125° に設定している。

【0016】上述のごとき本発明の複合アンテナは、一例として車の屋根などに搭載できるように、図6に示すごとく、アンテナ収容筐体に収容される。図6において、誘電体部材20の基部側に回路基板40が配設され、この回路基板40には衛星波および地上波の受信信号を増幅する低雑音増幅回路(図示せず)が搭載され、第1と第2の同軸線路26、32の他端が回路基板40に適宜に電気的接続されて、受信信号が低雑音増幅回路に入力される。そして、この低雑音増幅回路の増幅出力は、出力ケーブル42により導出される。また、複合アンテナを上から覆うように略円錐状の誘電体からなるレドーム44が設けられ、複合アンテナの下側には基台46が配設される。レドーム44と基台46により、水密的に複合アンテナを収容し得るアンテナ収容筐体48が構成される。さらに、基台46が適宜に車の屋根に貼着などにより適宜に固定され得る。

【0017】次に、本発明の第2実施例を図7を参照して説明する。図7は、本発明の複合アンテナの第2実施

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例の外観斜視図である。図7に示す第2実施例では、四角錐状で厚さが略一定な誘電体部材50の表面に、その頂点を一致させて導電金属板や導電金属薄膜などからなる四角錐状放射素子52が配設される。そして、誘電体部材50の頂点に上方に突出させてヘリカルコイルを含む垂直直線偏波受信アンテナ素子30が配設される。なお、誘電体部材50の裏面には図示しないグランドプレートが設けられ、また四角錐状放射素子52にも適宜な給電線が電気的接続されて、円偏波受信パッチアンテナが形成される。

【0018】図7に示す本発明の第2実施例にあっても、第1実施例と同様に、衛星波および地上波に対してともに低仰角の利得の向上が図れる。

【0019】さらに、本発明の第3実施例を図8を参照して説明する。図8は、本発明の複合アンテナの第3実施例の外観図であり、(a)は平面図、(b)は正面図である。図8に示す第3実施例で、第1実施例と相違するところは、円錐状放射素子22に対する給電線を、第1の同軸線路26に代えて、誘電体部材20の表面に設けた帯状の導電金属薄膜などからなるマイクロストリップ

プライン60で形成したものである。第1実施例と同様の作用効果が得られることは勿論である。

【0020】なお、上述の第1実施例では、第1と第2の同軸線路26、32を用いているが、同軸構造が形成されれば、いかなる構造のものであっても良い。また、第1実施例のごとく、円錐状の誘電体部材20の表面に平面投影形状が円形の円錐状放射素子22が設けられるものに限られず、平面投影形状が矩形(正方形および長方形を含む)のものや正方形の1つの隅が切り欠かれたものなどであっても良い。また、第2実施例のごとく、四角錐状の誘電体部材50の表面に平面投影形状が矩形の四角錐状放射素子52が設けられるものに限られず、平面投影形状が円形の錐状放射素子であっても良い。そして、第2実施例で、誘電体部材およびその表面に配設される錐状放射素子は、四角錐に限られず、五角錐や六角錐などいかなる角錐状であっても良い。さらに、誘電体部材は、楕円錐状や長方形の四角錐などであっても良い。誘電体部材20、50の表面に設けられる錐状放射素子は、その平面投影形状が円偏波を受信し得るいかなるパッチ形状であっても良い。さらに、実施例では、垂直直線偏波受信アンテナ素子30は、物理的長さを短くするためにヘリカルコイルを含んで形成されているが、物理的長さが長くても良ければポールアンテナで形成しても良いことは勿論であり、水平面内指向性が無指向なアンテナであればいかなる構造のものであっても良い。

【0021】

【発明の効果】以上説明したように本発明の複合アンテナは構成されているので、以下のごとき格別な効果を奏する。

【0022】請求項1記載の複合アンテナにあつては、

円偏波受信パッチアンテナを形成する放射素子を錐状としたことにより、衛星波を円偏波受信パッチアンテナで受信した垂直面内指向特性の低仰角において、および地上波を垂直直線偏波受信素子で受信した垂直面内指向特性の低仰角におけるいずれでも利得が改善される。しかも、衛星波に対して垂直上方から略±70°の低い仰角までの広い範囲で利得はほぼ一定である。そこで、衛星波に対して、これを受信する場所や複合アンテナの姿勢の変化などにより、受信感度が大幅に変化することがない。

【0023】請求項2記載の複合アンテナにあつては、全体を略円錐状に形成し、その頂点に物理的長さが短いヘリカルコイルを含んだ垂直直線偏波受信アンテナ素子を突設するので、全体を小型に構成するのに好適である。

【0024】請求項3記載の複合アンテナにあつては、円偏波受信パッチアンテナおよび垂直直線偏波受信アンテナ素子による受信信号を、第1と第2の同軸構造で導出するので、受信信号の導出経路における減衰を生じることがない。

【図面の簡単な説明】

【図1】本発明の複合アンテナの第1実施例の外観図であり、(a)は平面図、(b)は側面図である。

【図2】図1の(a)のA-A断面矢視拡大図である。

【図3】本発明の複合アンテナの円偏波受信パッチアンテナで衛星波を受信した垂直面内指向特性図である。

【図4】本発明の複合アンテナの垂直直線偏波受信アンテナ素子で地上波を受信した垂直面内指向特性図である。

【図5】本発明の複合アンテナの垂直直線偏波受信アンテナ素子で地上波を受信した水平面内指向特性図である。

【図6】図1の複合アンテナをアンテナ収容筐体に収容した縦断面図である。

【図7】本発明の複合アンテナの第2実施例の外観斜視図である。

【図8】本発明の複合アンテナの第3実施例の外観図であり、(a)は平面図、(b)は正面図である。

【図9】従来の複合アンテナの一例の斜視図である。

【図10】従来の複合アンテナの円偏波受信パッチアンテナで衛星波を受信した垂直面内指向特性図である。

【図11】従来の複合アンテナの垂直直線偏波受信アンテナ素子で地上波を受信して垂直面内指向特性図である。

【図12】従来の複合アンテナの垂直直線偏波受信アンテナ素子で地上波を受信した水平面内指向特性図である。

【符号の説明】

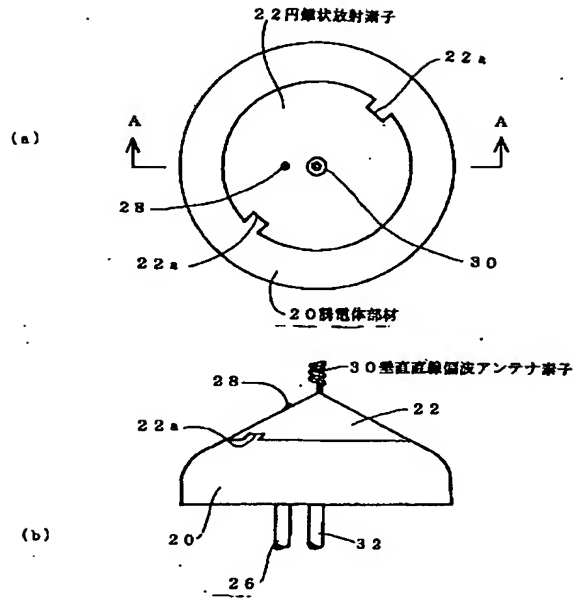
14、24 グランドプレート

18、30 垂直直線偏波受信アンテナ素子

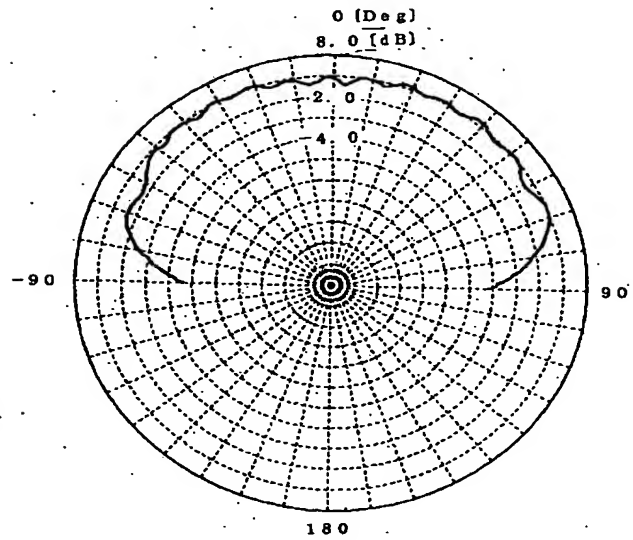
20、50 誘電体部材
22 円錐状放射素子
26 第1の同軸線路

32 第2の同軸線路
52 四角錐状放射素子
60 マイクロストリップライン

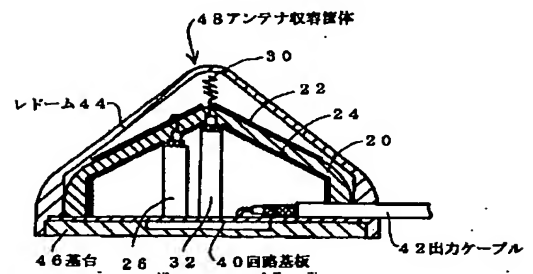
【図1】



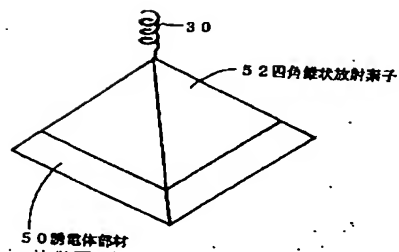
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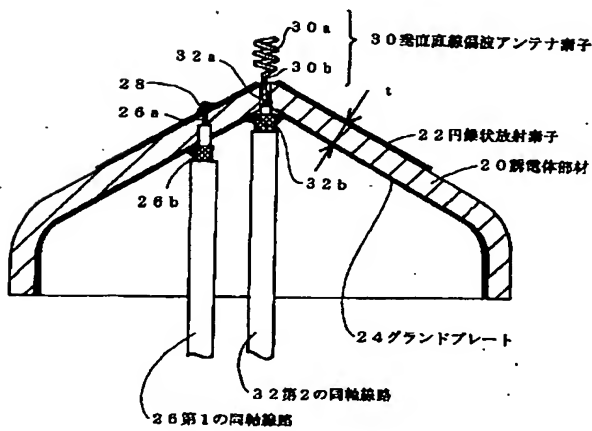
【図6】



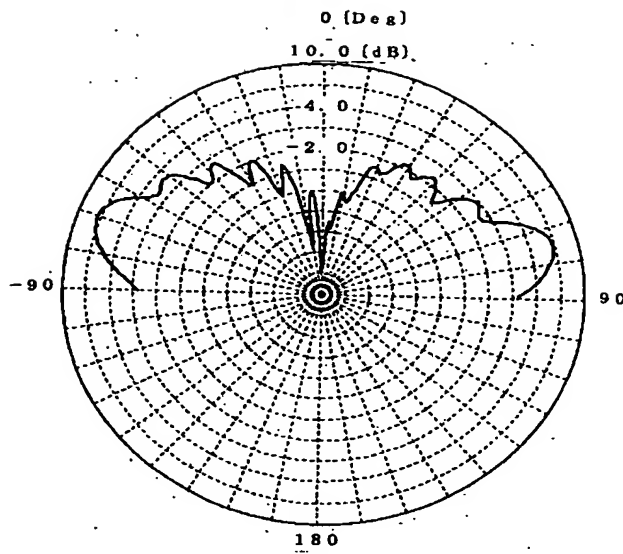
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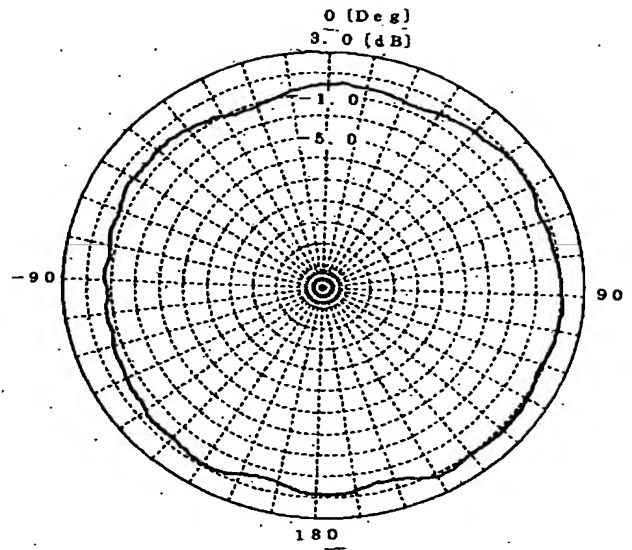
【図2】



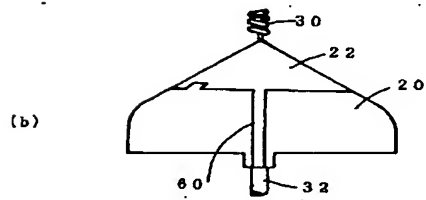
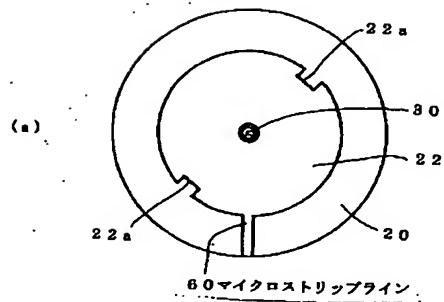
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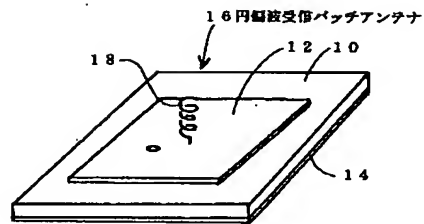
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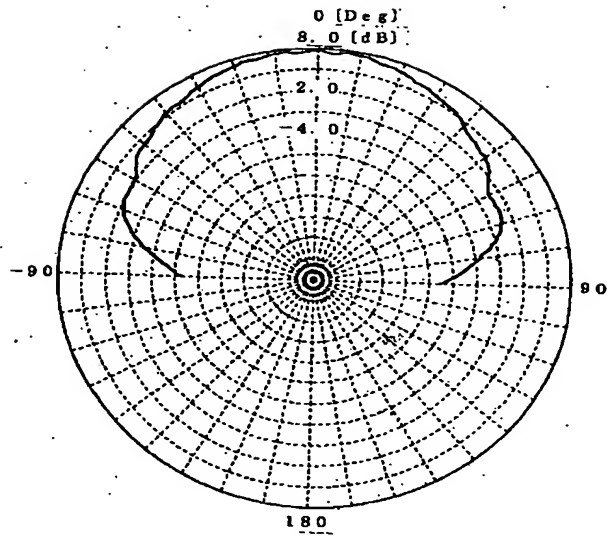
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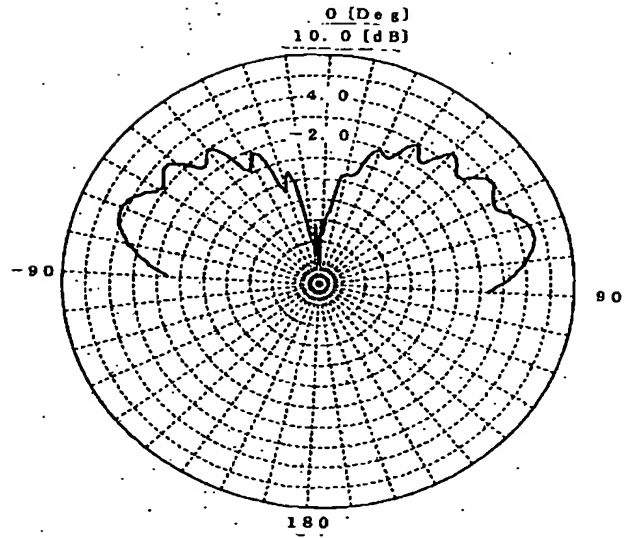
【図9】



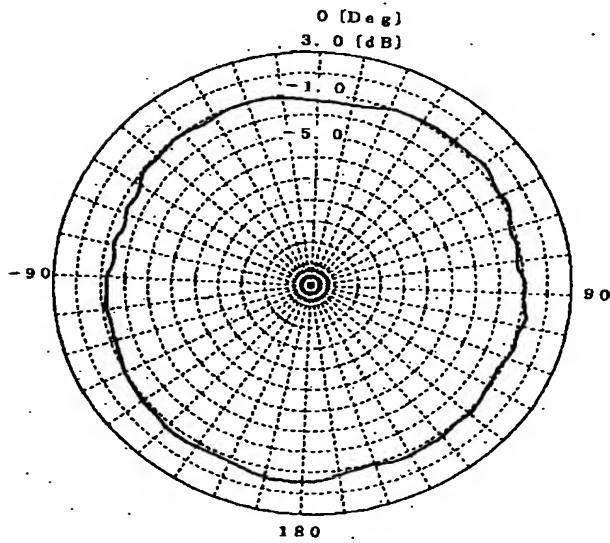
【図10】



【図11】



【図12】



フロントページの続き

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 PA07

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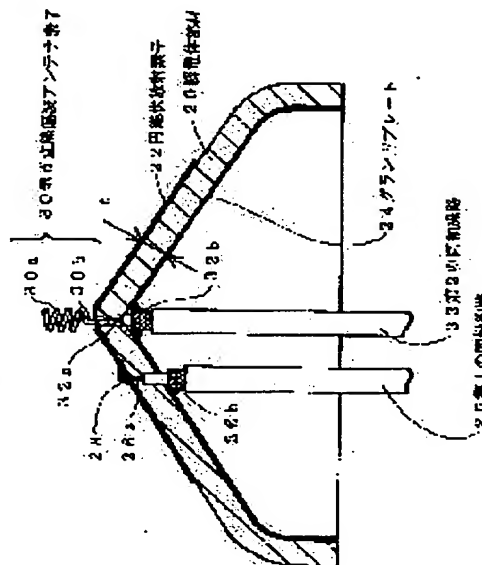
(72)Inventor : TERUNUMA KENICHI
UCHIDA HARUHISA

(54) COMPOSITE ANTENNA

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a composite antenna which receives broadcasting signals transmitted by both of satellite waves and ground waves, for which the change of a gain is less by the difference of an elevation angle and the gain is large even at low elevation angle for the satellite waves and the gain at the low elevation angle is large for the ground waves.

SOLUTION: On the surface of the dielectric member 20 of roughly fixed thickness in a conical shape projected upwards, a conical radiation element 22 is disposed with the vertex of the conical shape as a center. A ground plate 24 is disposed on the back surface of the dielectric member 20. The center conductor 26a of a first coaxial line 26 is electrically connected from the back surface side to the conical radiation element 22 and a circularly polarized wave receiving patch antenna capable of receiving circularly polarized waves is formed of the conical radiation element 22 and the ground plate 24 holding the dielectric member 20 there between. The outer conductor 26b of the first coaxial line 26 is electrically connected to the ground plate 24. Also, at the vertex of the conical shape of the dielectric member 20, a vertical linearly polarized wave receiving antenna element 30 formed including a helical coil and capable of receiving vertical linearly polarized waves is projected upwards and disposed.



LEGAL STATUS

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CLAIMS

[Claim(s)]

[Claim 1] It is the compound antenna which receives a satellite wave of a circularly-polarized wave, and a ground wave of a vertical linearly polarized wave. A drill-like radiating element is arranged in a front face of a fixed dielectric member centering on top-most vertices of the shape of said drill. the upper part -- a convex -- the shape of a drill -- thickness -- abbreviation -- A circularly-polarized-wave reception patch antenna which arranges a grand plate in a rear face of said dielectric member, connects a feeder to said drill-like radiating element, and can receive said circularly-polarized wave on said drill-like radiating element and grand plate is formed. A compound antenna characterized by having arranged a vertical linearly polarized wave receiving-antenna element which protrudes on top-most vertices of the shape of said drill of said dielectric member up, and can receive said vertical linearly polarized wave in the state of said drill-like radiating element and the insulation, and constituting it.

[Claim 2] A compound antenna characterized by having made said dielectric member into the shape of a cone, having arranged said conic drill-like radiating element in the front face in a compound antenna according to claim 1, and constituting said vertical linearly polarized wave receiving-antenna element including a helical coil.

[Claim 3] In a compound antenna according to claim 1 or 2 to said drill-like radiating element Penetrate said dielectric member from said grand plate side, and electrical installation of the central conductor of the 1st coaxial structure as said feeder is carried out. Electrical installation of the outer conductor of said 1st coaxial structure is carried out to said grand plate. A compound antenna which carries out electrical installation of the end face of said vertical linearly polarized wave receiving-antenna element to a central conductor of the 2nd coaxial structure, and is characterized by having carried out electrical installation of the outer conductor of said 2nd coaxial structure to said grand plate, and constituting it.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] This invention relates to the compound antenna for receiving both the broadcast signals transmitted on the both sides of satellite waves, such as the XM Satellite Radio broadcast by which broadcast is started in a U.S. mainland, and the Sirius satellite broadcast, and a ground wave.

[0002]

[Description of the Prior Art] An example of the conventional compound antenna which both receives the satellite wave transmitted from a satellite and the ground wave which receive this in an earth station, and a modulation technique is made different, and is again transmitted from an earth station is explained with reference to drawing 9 .

[0003] Drawing 9 is the perspective diagram of an example of the conventional compound antenna. In drawing 9 , the rectangular field-like radiating element 12 is arranged in the front face of the dielectric board 10, the grand plate 14 is arranged in the rear face of the dielectric board 10, electrical installation of the feeder (not shown) which penetrated the dielectric board 10 from the rear-face side to the field-like radiating element 12 is carried out, and the circularly-polarized-wave reception patch antenna 16 which receives the satellite wave of the circularly-polarized wave transmitted from a satellite with the field-like radiating element 12 and the grand plate 14 is constituted. Moreover, the vertical linearly polarized wave receiving-antenna element 18 which protrudes up, is constituted including a helical coil and receives the ground wave of a vertical linearly polarized wave is arranged in the center position of the field-like radiating element 12. In addition, the vertical linearly polarized wave receiving-antenna element 18 is in an insulating condition in the field-like radiating element 12.

[0004] the directional characteristics of the conventional compound antenna of this configuration -- drawing 10 thru/or drawing 12 -- like -- it comes out. Drawing 10 is directional-characteristics drawing within a vertical plane which received the satellite wave with the circularly-polarized-wave reception patch antenna 16. Drawing 11 is directional-characteristics drawing within a vertical plane which received the ground wave with the vertical linearly polarized wave receiving-antenna element 18. Drawing 12 is directional-characteristics drawing within the level surface which received the ground wave with the vertical linearly polarized wave receiving-antenna element 18.

[0005]

[Problem(s) to be Solved by the Invention] If it is in the conventional compound antenna shown in drawing 9 , as shown in drawing 12 , the directional characteristics within the level surface show indirectivity to the ground wave. Moreover, although not illustrated, of course, the directional characteristics within the level surface show indirectivity to a satellite wave. However, as shown in drawing 10 , gain falls, so that vertical upper gain is the largest and an elevation angle becomes low to a satellite wave. This will produce change in receiving sensitivity by the position in which a compound antenna is installed by the location to receive again etc. And as shown in drawing 11 , gain [in / to a ground wave / a horizontal low elevation angle] is small. In order to obtain good receiving sensitivity to a ground wave, it is desirable for the gain of

a horizontal low elevation angle to be large.

[0006] It aims at offering the compound antenna which has improved so that there may be little change of gain, gain may be [this invention may be made in view of the situation of the conventional technology like ****, it may be a thing] large by the difference of an elevation angle to a satellite wave also at a low elevation angle again and the gain of a low elevation angle may become [as opposed to / further / a ground wave] larger.

[0007]

[Means for Solving the Problem] In order to attain this object, a compound antenna of this invention It is the compound antenna which receives a satellite wave of a circularly-polarized wave, and a ground wave of a vertical linearly polarized wave. A drill-like radiating element is arranged in a front face of a fixed dielectric member centering on top-most vertices of the shape of said drill. the upper part -- a convex -- the shape of a drill -- thickness -- abbreviation -- A circularly-polarized-wave reception patch antenna which arranges a grand plate in a rear face of said dielectric member, connects a feeder to said drill-like radiating element, and can receive said circularly-polarized wave on said drill-like radiating element and grand plate is formed. A vertical linearly polarized wave receiving-antenna element which protrudes on top-most vertices of the shape of said drill of said dielectric member up, and can receive said vertical linearly polarized wave is arranged in the state of said drill-like radiating element and an insulation, and it is constituted.

[0008] And said dielectric member may be made into the shape of a cone, said conic drill-like radiating element may be arranged in the front face, and said vertical linearly polarized wave receiving-antenna element may be constituted including a helical coil.

[0009] Moreover, said dielectric member is penetrated to said drill-like radiating element from said grand plate side, electrical installation of the central conductor of the 1st coaxial structure as said feeder is carried out to it, electrical installation of the outer conductor of said 1st coaxial structure is carried out to said grand plate, electrical installation of the end face of said vertical linearly polarized wave receiving-antenna element is carried out to a central conductor of the 2nd coaxial structure, electrical installation of the outer conductor of said 2nd coaxial structure can be carried out to said grand plate, and it can also be constituted.

[0010]

[Embodiment of the Invention] Hereafter, the 1st example of this invention is explained with reference to drawing 1 thru/or drawing 6 . Drawing 1 is the external view of the 1st example of the compound antenna of this invention, (a) is a plan and (b) is a side elevation. Drawing 2 is the A-A cross-section view enlarged view of (a) of drawing 1 . Drawing 3 is directional-characteristics drawing within a vertical plane which received the satellite wave with the circularly-polarized-wave reception patch antenna. Drawing 4 is directional-characteristics drawing within a vertical plane which received the ground wave with the vertical linearly polarized wave receiving-antenna element. Drawing 5 is directional-characteristics drawing within the level surface which received the ground wave with the vertical linearly polarized wave receiving-antenna element. Drawing 6 is drawing of longitudinal section which held the compound antenna of drawing 1 in the antenna hold case.

[0011] if it is in the compound antenna of this invention -- the upper part -- a convex -- the shape of a cone -- thickness t -- abbreviation -- the conic cone-like radiating element 22 which consists of an electric conduction metal plate, an electric conduction metal thin film, etc. is arranged in the front face of the fixed dielectric member 20. The cone-like radiating element 22 is arranged centering on the top-most vertices of the dielectric member 20, and the top-most vertices are in agreement. And the notching-like perturbation elements 22a and 22a are formed in two places which counter the edge of the cone-like radiating element 22 at a radial. Moreover, the grand plate 24 which consists of an electric conduction metal thin film etc. all over the rear-face abbreviation for the dielectric member 20 is arranged. Furthermore, central conductor 26a of the 1st coaxial track 26 penetrates the dielectric member 20 from a rear-face side, and electrical installation is suitably carried out to the cone-like radiating element 22 in a front face by soldering 28 etc. Moreover, electrical installation of the outer-conductor 26b of the 1st coaxial track 26 is suitably carried out to the grand plate 24 by soldering etc. It has and a conic

circularly-polarized-wave reception patch antenna is formed with the cone-like radiating element 22 and the grand plate 24 which were prepared on both sides of the dielectric member 20. In addition, the vertical angle is 125 degrees and the size from top-most vertices to an edge of the cone-like radiating element 22 for receiving the satellite wave of the 2.3GHz circularly-polarized wave of the transmit frequencies of the XM Satellite Radio broadcast as an example is 25mm. What the dimension to the received frequency of this cone-like radiating element 22 should be suitably set up for with the dielectric constant of the dielectric member 20 is natural.

[0012] Furthermore, the vertical linearly polarized wave receiving-antenna element 30 which protrudes up and by which its helical-coil section 30a and end face side is set to bay 30b is arranged in the conic top-most vertices of the dielectric member 20. Bay 30b penetrates the top-most vertices of the dielectric member 20 perpendicularly, and electrical installation is carried out to central conductor 32a of the 2nd coaxial track 32 established in a rear-face side. Electrical installation of the outer-conductor 36b of this 2nd coaxial track 32 is suitably carried out to the grand plate 24 of the rear face of the dielectric member 20 by soldering etc. In addition, this vertical linearly polarized wave receiving-antenna element 30 is made into the condition of having been insulated to the cone-like radiating element 22. And an upper portion acts as an antenna from the grand plate 24, and as an example, the vertical linearly polarized wave receiving-antenna element 30 is set as electric merit with a quarter-wave length [of the transmit frequencies of broadcast] of 2.3GHz so that it may be made to resonate.

[0013] the directional characteristics within a vertical plane received by the cone-like radiating element 22 to the satellite wave as shown in drawing 3 if it was in the compound antenna of this invention of this configuration -- from the vertical upper part up to the low elevation angle of **70 degrees of abbreviation -- receiving sensitivity -- about 5dB and abbreviation -- even if it is the same and is moreover in a **90-degree low elevation angle, as compared with the conventional compound antenna indicated to be -5dB to drawing 10 , gain is improving about 3dB of abbreviation. Then, there is little change of receiving sensitivity by the position in which the compound antenna of a location or this invention which receives this is installed to a satellite wave. And the receiving sensitivity in a low elevation angle is improving. It has and a satellite wave can be received certainly. In addition, although the directional characteristics within the level surface over a satellite wave are not illustrated, they are natural. [of it being indirectivity]

[0014] And as shown in drawing 4 , as compared with the conventional compound antenna indicated to be about 1dB to drawing 11 in a **90-degree low elevation angle, gain of directivity on vertical plane which received by the vertical linearly polarized wave antenna element 30 is improving about 3dB of abbreviation to a ground wave. Thereby, improvement in receiving sensitivity can be aimed at about 3dB of abbreviation to the ground wave.

[0015] Although it is thought here that the gain of a **90-degree low elevation angle is improved by making this reflecting plate into the shape of a cone with a small vertical angle since the cone-like radiating element 22 acts as a reflecting plate to the vertical linearly polarized wave antenna element 30 Even if it only decreases the vertical angle of the cone-like radiating element 22 from 180 degrees, the gain of the **90-degree low elevation angle of the vertical linearly polarized wave antenna element 30 does not improve uniformly, and an increment and reduction arise by turns. Then, artificers have set the vertical angle of the cone-like radiating element 22 as a reflecting plate as 125 degrees by experiment.

[0016] As shown in drawing 6 , the compound antenna of this invention like **** is held in an antenna hold case, so that it can carry in the roof of a vehicle etc. as an example. In drawing 6 , the circuit board 40 is arranged in the base side of the dielectric member 20, the low noise amplifying circuit (not shown) which amplifies a satellite wave and a terrestrial input signal is carried in this circuit board 40, electrical installation of the other end of the 1st and the 2nd coaxial track 26 and 32 is suitably carried out to the circuit board 40, and an input signal is inputted into a low noise amplifying circuit. And the amplification output of this low noise amplifying circuit is drawn by the output cable 42. Moreover, the radome 44 which consists of an approximate circle drill-like dielectric is formed so that a compound antenna may be covered from a top, and a pedestal 46 is arranged in the compound antenna bottom. The antenna hold case 48 which can hold a compound antenna in watertight is constituted by a radome 44 and the

pedestal 46. Furthermore, a pedestal 46 may be suitably fixed to the roof of a vehicle by attachment etc.

[0017] Next, the 2nd example of this invention is explained with reference to drawing 7. Drawing 7 is the appearance perspective diagram of the 2nd example of the compound antenna of this invention. the 2nd example shown in drawing 7 -- the shape of a rectangular-head drill -- thickness -- abbreviation -- the rectangular-head drill-like radiating element 52 which the top-most vertices are made in agreement, and consists of an electric conduction metal plate, an electric conduction metal thin film, etc. is arranged in the front face of the fixed dielectric member 50. And the vertical linearly polarized wave receiving-antenna element 30 which the top-most vertices of the dielectric member 50 are made to project up, and contains a helical coil is arranged. In addition, the grand plate which is not illustrated is prepared in the rear face of the dielectric member 50, and electrical installation of the proper feeder is carried out also to the rectangular-head drill-like radiating element 52, and a circularly-polarized-wave reception patch antenna is formed.

[0018] Even if it is in the 2nd example of this invention shown in drawing 7, improvement in the gain of a low elevation angle can be aimed at [as opposed to / both / a satellite wave and a ground wave] like the 1st example.

[0019] Furthermore, the 3rd example of this invention is explained with reference to drawing 8. Drawing 8 is the external view of the 3rd example of the compound antenna of this invention, (a) is a plan and (b) is front view. The place which is different from the 1st example in the 3rd example shown in drawing 8 replaces the feeder to the cone-like radiating element 22 with the 1st coaxial track 26, and forms it by the microstrip line 60 which consists of a band-like electric conduction metal thin film prepared in the front face of the dielectric member 20. Of course, the same operation effect as the 1st example is acquired.

[0020] In addition, although the 1st and the 2nd coaxial track 26 and 32 are used in the 1st above-mentioned example, as long as coaxial structure is formed, you may be the thing of what kind of structure. Moreover, like the 1st example, it was not restricted to that by which the cone-like radiating element 22 with a circular flat-surface projection configuration is formed in the front face of the conic dielectric member 20, but one corner of a rectangular (a square and a rectangle are included) thing or a square could cut, and the flat-surface projection configuration could lack. Moreover, like the 2nd example, a flat-surface projection configuration may not be restricted to that in which the rectangular rectangular-head drill-like radiating element 52 is formed on the front face of the rectangular-head drill-like dielectric member 50, but a flat-surface projection configuration may be a circular drill-like radiating element. And the drill-like radiating element arranged in a dielectric member and its front face in the 2nd example may not be restricted to a rectangular-head drill, but may be what kind of pyramids-like, such as a pentagonal pyramid and a hexagon-head drill. Furthermore, dielectric members may be the shape of an elliptic cone, a rectangular rectangular-head drill, etc. The drill-like radiating element prepared in the front face of the dielectric members 20 and 50 may be what kind of patch configuration in which the flat-surface projection configuration can receive a circularly-polarized wave. Furthermore, in the example, the vertical linearly polarized wave receiving-antenna element 30 of it being formed including the helical coil, in order to shorten physical length, but your forming with a pole antenna, as long as physical length may be long may be natural, and as long as the directivity within the level surface is an antenna [**** /-less], you may be the thing of what kind of structure.

[0021]

[Effect of the Invention] Since the compound antenna of this invention is constituted as explained above, the following solves and an exceptional effect is done so.

[0022] If it is in a compound antenna according to claim 1, in the low elevation angle of the directional characteristics within a vertical plane which received the satellite wave with the circularly-polarized-wave reception patch antenna, gain is improved for either in the low elevation angle of the directional characteristics within a vertical plane which received the ground wave with the vertical linearly polarized wave receiving element by having made into the shape of a drill the radiating element which forms a circularly-polarized-wave reception patch

antenna. And gain is almost fixed to a satellite wave in the large range from the vertical upper part to the low elevation angle of ~ 70 degrees of abbreviation. Then, receiving sensitivity does not change with change of the position of a location or a compound antenna in which this is received etc., substantially to a satellite wave.

[0023] If it is in a compound antenna according to claim 2, since the vertical linearly polarized wave receiving-antenna element in which the whole was formed in in the shape of an approximate circle drill, and physical length contained the short helical coil at the top-most vertices is protruded, it is suitable to constitute the whole small.

[0024] If it is in a compound antenna according to claim 3, since the input signal by the circularly-polarized-wave reception patch antenna and the vertical linearly polarized wave receiving-antenna element is derived with the 1st and 2nd coaxial structure, the attenuation in the derivation path of an input signal is not produced.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the external view of the 1st example of the compound antenna of this invention, and (a) is a plan and (b) is a side elevation.

[Drawing 2] It is the A-A cross-section view enlarged view of (a) of drawing 1 .

[Drawing 3] It is directional-characteristics drawing within a vertical plane which received the satellite wave with the circularly-polarized-wave reception patch antenna of the compound antenna of this invention.

[Drawing 4] It is directional-characteristics drawing within a vertical plane which received the ground wave with the vertical linearly polarized wave receiving-antenna element of the compound antenna of this invention.

[Drawing 5] It is directional-characteristics drawing within the level surface which received the ground wave with the vertical linearly polarized wave receiving-antenna element of the compound antenna of this invention.

[Drawing 6] It is drawing of longitudinal section which held the compound antenna of drawing 1 in the antenna hold case.

[Drawing 7] It is the appearance perspective diagram of the 2nd example of the compound antenna of this invention.

[Drawing 8] It is the external view of the 3rd example of the compound antenna of this invention, and (a) is a plan and (b) is front view.

[Drawing 9] It is the perspective diagram of an example of the conventional compound antenna.

[Drawing 10] It is directional-characteristics drawing within a vertical plane which received the satellite wave with the circularly-polarized-wave reception patch antenna of the conventional compound antenna.

[Drawing 11] A ground wave is received with the vertical linearly polarized wave receiving-antenna element of the conventional compound antenna, and it is directional-characteristics drawing within a vertical plane.

[Drawing 12] It is directional-characteristics drawing within the level surface which received the ground wave with the vertical linearly polarized wave receiving-antenna element of the conventional compound antenna.

[Description of Notations]

14 24 Grand plate

18 30 Vertical linearly polarized wave receiving-antenna element

20 50 Dielectric member

22 Cone-like Radiating Element

26 1st Coaxial Track

32 2nd Coaxial Track

52 Rectangular-Head Drill-like Radiating Element

60 Microstrip Line

[Translation done.]

* NOTICES *

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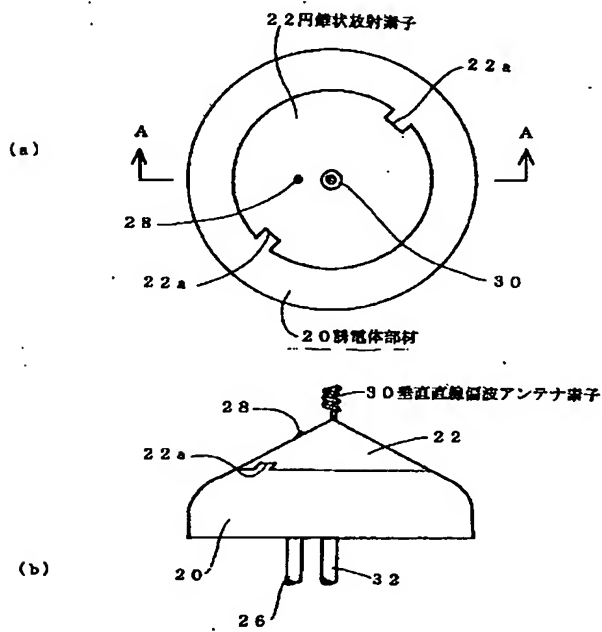
1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.*** shows the word which can not be translated.

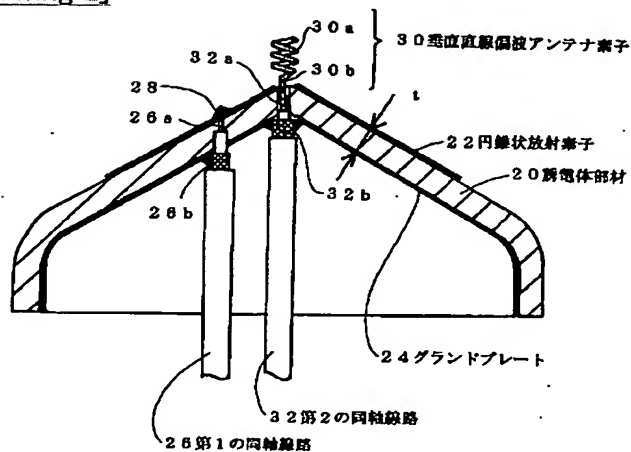
3.In the drawings, any words are not translated.

DRAWINGS

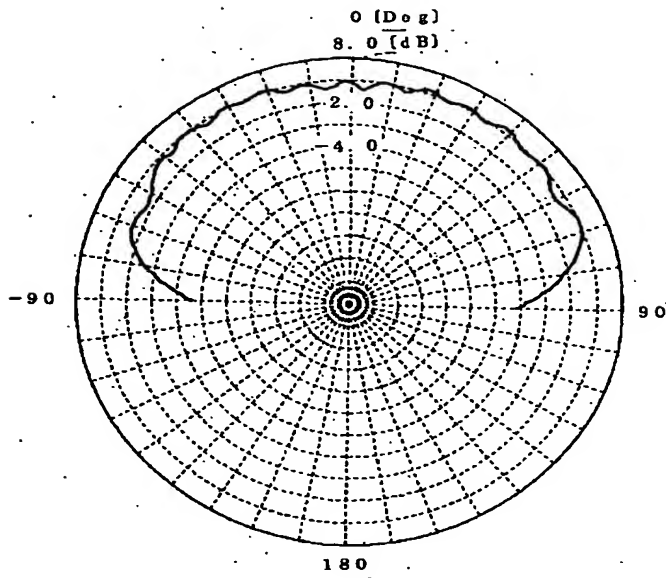
[Drawing 1]



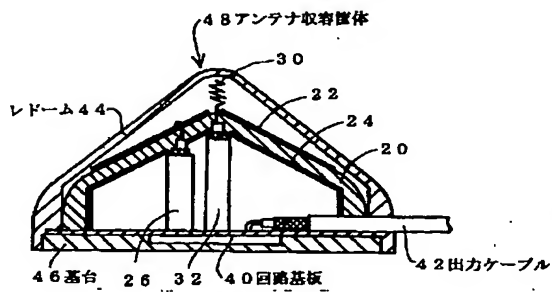
[Drawing 2]



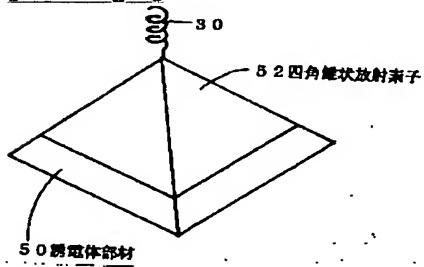
[Drawing 3]



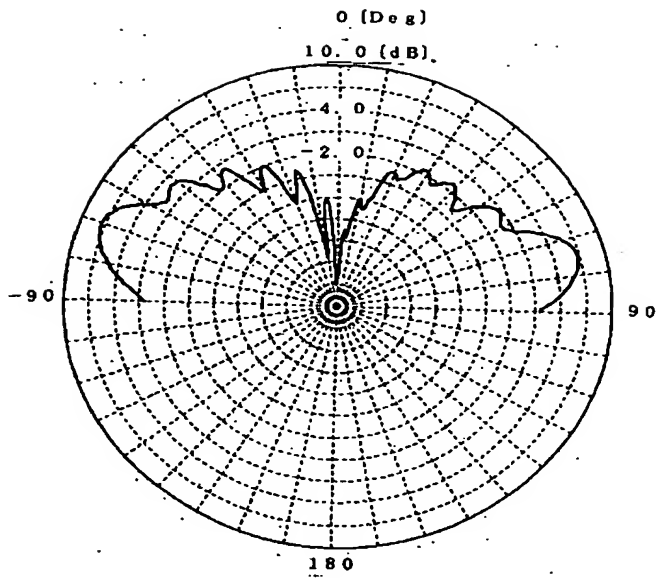
[Drawing 6]



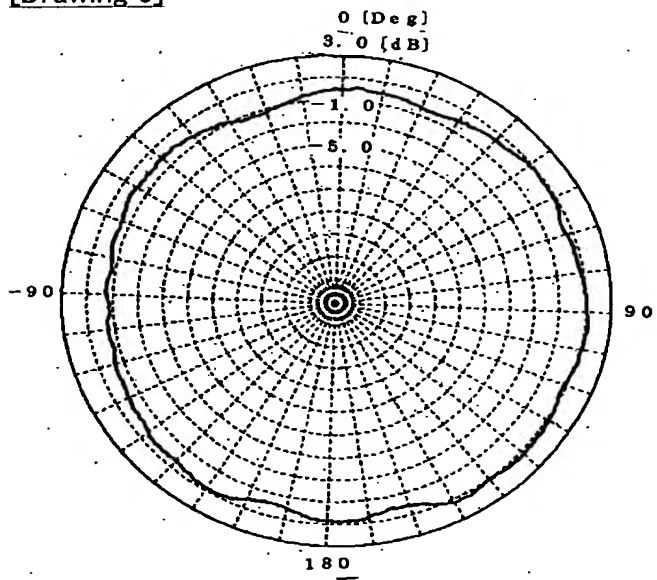
[Drawing 7]



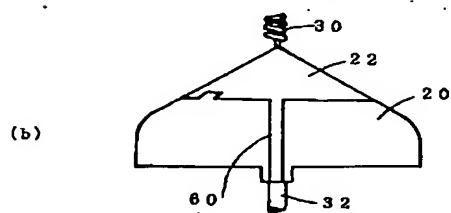
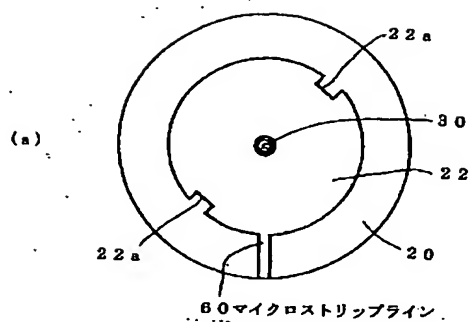
[Drawing 4]



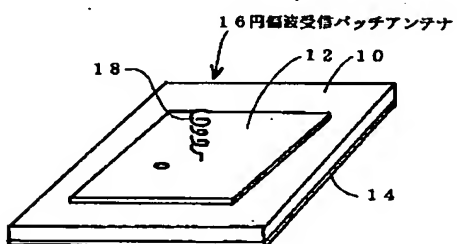
[Drawing 5]



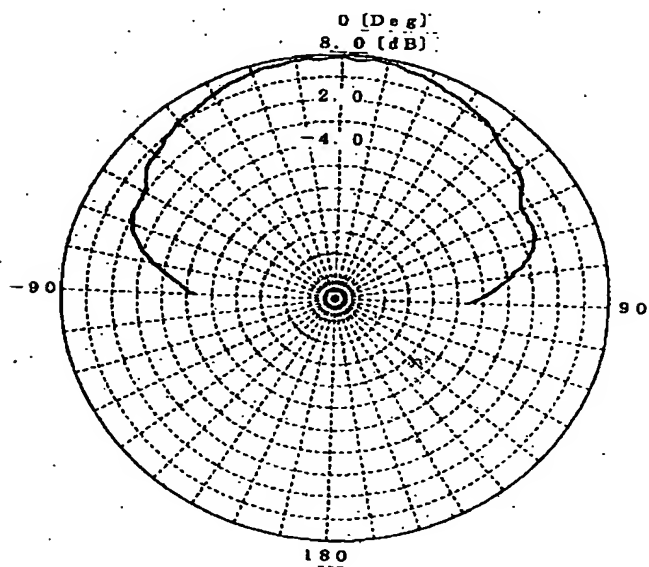
[Drawing 8]



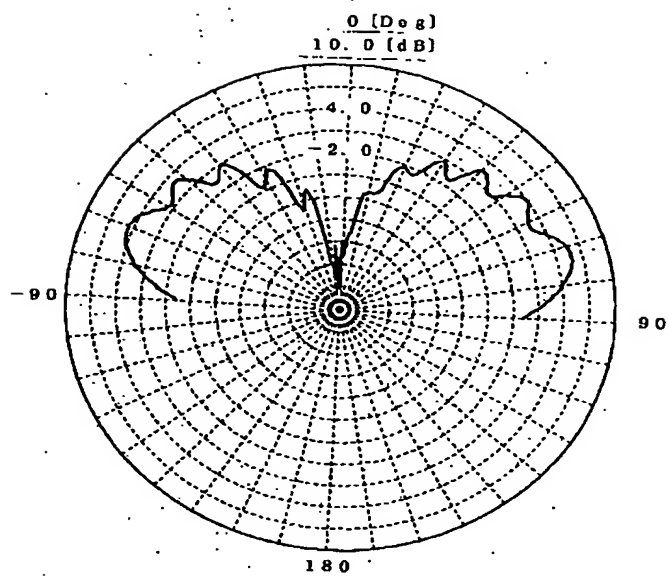
[Drawing 9]



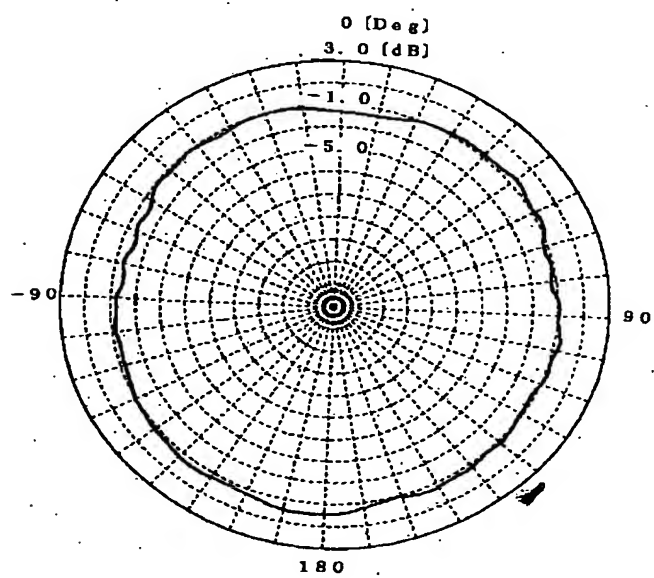
[Drawing 10]



[Drawing 11]



[Drawing 12]



[Translation done.]